

I CLAIM:

1. A bone screw comprising:

- a) a proximal portion comprising a head with a proximal end and a portal;
- b) a distal portion comprising threads and a tip with a distal end; and
- c) a central lumen configured to receive a guidewire extending coaxially completely

5 through the bone screw from the proximal end to the distal end;

where the head comprises a proximal portion configured to mate with the tip of a screwdriver.

2. The bone screw of claim 1, where the proximal portion comprises a slot.

10 3. The bone screw of claim 1, where the proximal portion is configured to mate with a Phillips head screwdriver.

4. The bone screw of claim 1, where the proximal portion comprises a raised platform having a plurality of substantially straight sides.

15 5. The bone screw of claim 1, where the portal has a minimum diameter of between about 4 mm and about 8 mm in a proximal to distal plane.

6. The bone screw of claim 1, where the portal has a minimum diameter of about 6 mm in a proximal to distal plane.

7. The bone screw of claim 1, where the distal portion comprises at least one perforation completely laterally through the distal portion.

20 8. A screwdriver comprising:

a) a proximal end comprising a handle configured to permit grasping of the screwdriver and to permit the application of torque to a bone screw;

b) a distal end comprising a shaft having a tip configured to interface with a bone screw; and

25 c) a central lumen configured to receive a guidewire extending coaxially completely through the screwdriver from the proximal end to the distal end.

9. An inflatable connection rod comprising:

- a) a proximal end comprising a self-sealing valve;
- b) a distal end comprising a tip; and
- c) a compliant, inflatable balloon between the proximal end and the distal end.

10. The inflatable connection rod of claim 9, where the balloon comprises thin, reinforcing wires.

5 11. A directing sheath comprising:

- a) a proximal portion with a proximal end;
- b) a distal portion with a distal end;
- c) a central portion between the proximal portion and the distal portion comprising at

10 least two openings; and

15 d) a lumen extending through the directing sheath from the proximal end to distal end; where the directing sheath is scored along its longitudinal axis to allow the directing sheath to be split into two separate halves by peeling the directing sheath apart at either its proximal end or its distal end or both along the scoring.

12. The directing sheath of claim 11, further comprising a radiopaque filament running the longitudinal length of the directing sheath from the proximal end to the distal end and passing around each opening in the central portion.

13. A method of repositioning or fixing one or more unstable, separated or displaced vertebrae or one or more portions of one or more vertebrae in a patient's vertebral column, the 20 method comprising:

- a) identifying a patient who is a suitable candidate for undergoing the method;
- b) making a stab incision in the patient's skin overlying the patient's vertebral column at or near the level of the vertebrae or portion of vertebrae to be repositioned or fixed;
- c) creating a first tract from the incision to the posterior periosteal surface of the 25 vertebrae;
- d) incising the periosteum and extending the first tract into the cortex of the vertebrae;
- e) inserting a first guidewire into the first tract;

f) advancing a bone screw comprising a portal and a tip, and a screwdriver over the first guidewire;

5 g) applying torque to the bone screw using the screwdriver, thereby fixing part of the tip of the bone screw into the vertebrae while the portal of the bone screw is exterior and dorsal to the vertebrae and the portal is open parallel to the long axis of the vertebral column;

h) removing the screwdriver and the first guidewire;

10 i) repeating c) through h) for at least one vertebrae which is neither unstable, separated or displaced and which is adjacent to the vertebrae or portion of the vertebrae that is being repositioned or fixed, or repeating c) through h) for the cranial-ward portion of the sacrum of the patient;

j) inserting an inflatable connection rod comprising a proximal end, a distal end and an inflatable balloon between the proximal end and the distal end, between the portals of the bone screws; and

15 k) inflating the inflatable balloon thereby creating a rigid structure between the inflated inflatable connection rod and the bone screws;

thereby repositioning or fixing the one or more unstable, separated or displaced vertebrae or the one or more portions of one or more vertebrae unilaterally.

20 14. The method of claim 13, where identifying a patient who is a suitable candidate comprises identifying a patient who has one or more unstable vertebrae, one or more portions of a vertebrae at least partly separated from the remainder of the vertebrae with potential or complete separation, or who has one or more vertebrae or a portion of one or more vertebrae displaced from its normal position relative to the vertebral column, or who has one or more portions of a vertebrae at least partly separated from the remainder of the vertebrae and displaced from its normal position relative to the vertebral column; and

25 where the patient has either pain, loss of function or real or potential instability which is likely due to the separation or displacement, or separation and displacement.

15. The method of claim 13, further comprising enlarging the first tract from the

incision to the posterior periosteal surface using a high-pressure fascial dilator balloon after creating the first tract.

16. The method of claim 13, where inserting an inflatable connection rod comprises:

- 5 i) percutaneously inserting a hollow needle and advancing the hollow needle to the portal of one of the bone screws;
- ii) introducing a second guidewire through the lumen of the hollow needle and into the portal of one of the bone screws; and
- iii) passing the second guidewire through all of the portals in the bone screws, thereby creating a second tract.

10 17. The method of claim 16, further comprising:

- i) dilating the second tract created by the second guidewire using a high pressure balloon;
- ii) passing an introducer sheath over the guidewire along the entire guidewire second tract;
- 15 iii) removing the guidewire; and
- iv) advancing the inflatable connection rod through the introducer sheath until the inflatable connection rod advances between the bone screw portals.

18. The method of claim 16, further comprising using a guidewire directing device to direct the advancing second guidewire through at least one bone screw portal.

20 19. The method of claim 16, further comprising using a guidewire capture device to pull the second guidewire through the patient's skin.

20. The method of claim 13, where inflating the inflatable balloon comprises inflating the balloon with a rapid setting, liquid polymer.

21. The method of claim 20, where the liquid polymer is light activated polymer.

25 22. The method of claim 13, further comprising repeating c) through h) for one additional vertebrae, where the one additional vertebrae is either unstable, separated or displaced, or where one or more portions of the one additional vertebrae is unstable, separated

or displaced.

23. The method of claim 13, further comprising repeating b) through k) on the opposite side of the spinous processes of the patient's vertebrae column, thereby repositioning or fixing the one or more unstable, separated or displaced vertebrae or the one or more portions of one or more vertebrae bilaterally.

5 24. The method of claim 13, further comprising using a directing sheath to position the bone screws.

25. The method of claim 13, where the bone screw comprises a central lumen and where the method further comprises injecting bone matrix material into the central lumen.

10 26. A method of repositioning or fixing a first vertebrae that is unstable, separated or displaced or that has one or more unstable, separated or displaced portions, the method comprising:

a) fixing one or more than one bone screw in the first vertebrae and one or more than one bone screw in a second vertebrae;

15 b) inserting an inflatable balloon between the portal of the bone screw in the first vertebrae and the portal of the bone screw in the second vertebrae; and

c) inflating the inflatable balloon thereby creating a rigid structure between the balloon and the bone screws;

thereby repositioning or fixing the first vertebrae or portion of the first vertebrae.

20 27. The method of claim 26, further comprising advancing each bone screw over a guidewire before a).

28. The method of claim 26, where a) comprises applying torque to each bone screw using a screwdriver advanced over a guidewire.

25 29. The method of claim 26, where c) comprises inflating the balloon with a rapid setting, liquid polymer.

30. The method of claim 26, further comprising repeating a) through c) on the opposite side of the spinous processes of the patient's vertebrae column, thereby bilaterally

repositioning or fixing the one or more unstable, separated or displaced vertebrae or the one or more portions of one or more vertebrae.

31. The method of claim 26, further comprising using a directing sheath to position the bone screws before a).

5 32. A kit for repositioning or fixing a first vertebrae that is unstable, separated or displaced or that has one or more unstable, separated or displaced portions, the kit comprising a plurality of bone screws of claim 1.

10 33. A kit for repositioning or fixing a first vertebrae that is unstable, separated or displaced or that has one or more unstable, separated or displaced portions, the kit comprising a screwdriver of claim 9.

34. A kit for repositioning or fixing a first vertebrae that is unstable, separated or displaced or that has one or more unstable, separated or displaced portions, the kit comprising an inflatable connection rod of claim 10.

15 35. A kit for repositioning or fixing a first vertebrae that is unstable, separated or displaced or that has one or more unstable, separated or displaced portions, the kit comprising a directing sheath of claim 11.